Inventory Results on
Coarse Woody Debris
(Preliminary Findings)
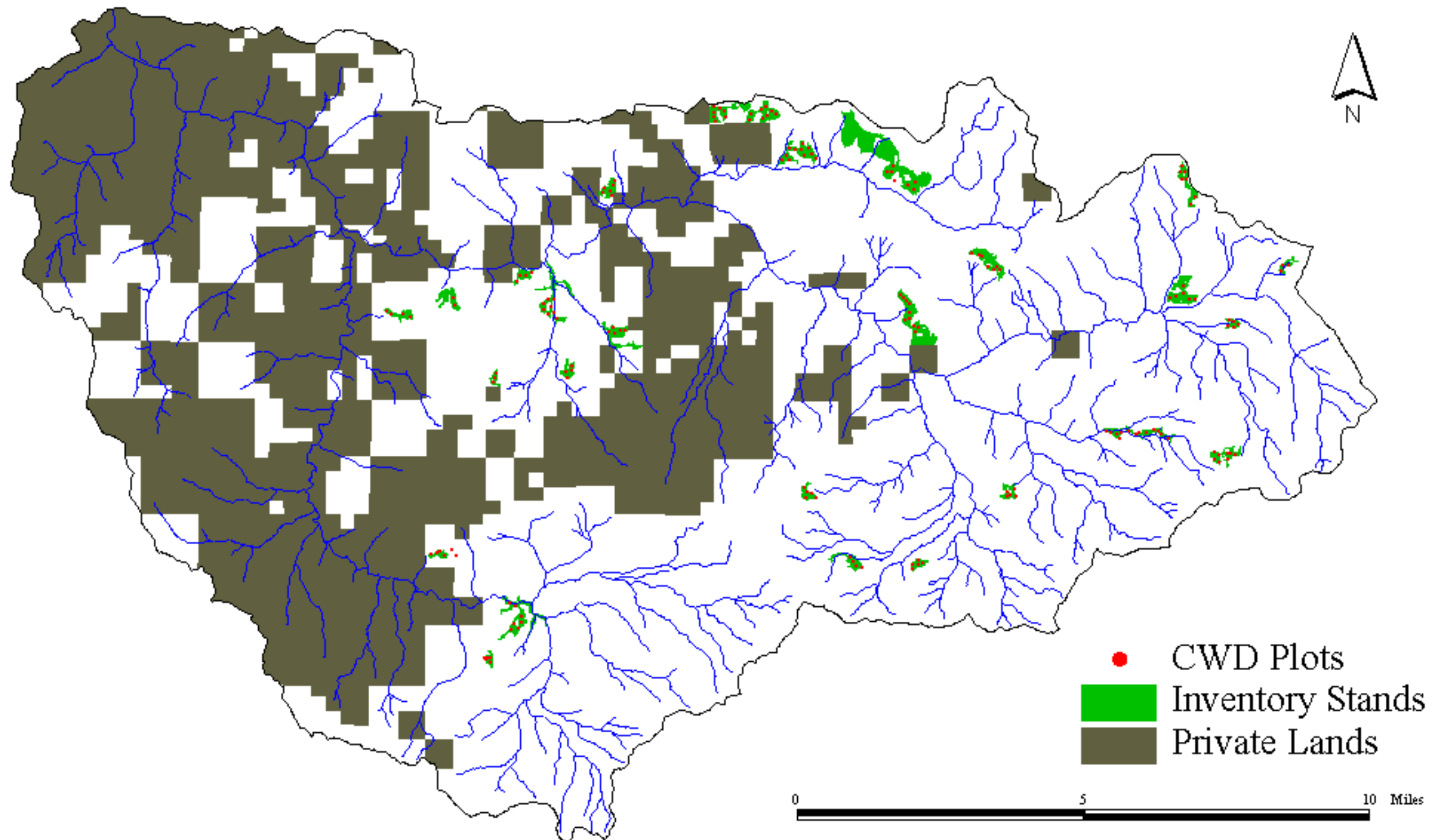
Little River
Adaptive Management Area

Prepared By
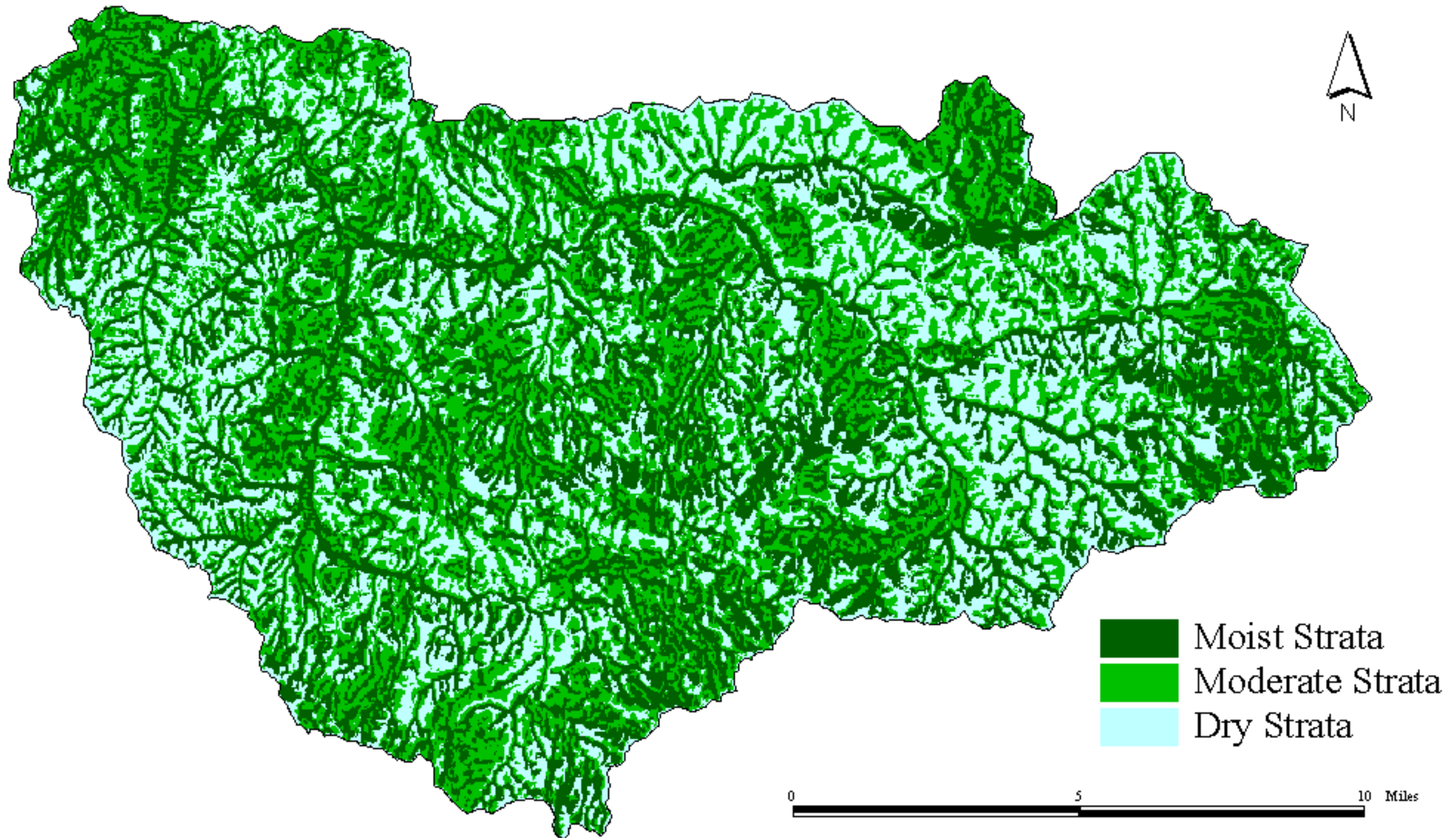**Raymond J. Davis**
October 1998

Little River Adaptive Management Area
CWD Inventory Plot Locations

Legend:
- CWD Plots
- Inventory Stands
- Private Lands

0 — 5 — 10 Miles

Little River Adaptive Management Area
Landscape Stratification

N

Moist Strata
Moderate Strata
Dry Strata

0   5   10 Miles

INTRODUCTION

This report documents preliminary findings from a coarse woody debris (CWD) inventory performed in the Little River Adaptive Management Area (AMA) from May-July 1998. This inventory was funded and administered through a cooperative agreement between the U.S. Fish and Wildlife Service , the Bureau of Land Management and the U.S. Forest Service. The purpose of the inventory was to collect data on the coarse woody debris resource within unmanaged late-successional forests of the Little River watershed and to assess its occurrence and distribution within ecological units.

It is hoped that this inventory will provide insight into how CWD is distributed across the forested landscape providing land managers information on how to manage for it. The inventory design also looks at ways to stratify a watershed into ecological units based on abiotic factors relating to forest vegetation, productivity, natural disturbance regimes and CWD levels.

BACKGROUND

The term coarse woody debris refers to snags, fallen trees, large limbs and branches that occur naturally in all forest ecosystems. It is a major structural element of late-successional forests with many crucial ecological functions. It provides habitat for many wildlife species and is a necessary component for maintaining the long-term health of the forest ecosystem.

The Northwest Forest Plan gives specific direction to develop models to guide us with CWD management in the Matrix and Adaptive Management Area land allocations (ROD C-40). Information from these models is to be used as a baseline for managers to develop prescriptions for landscape management. The objective is to provide coarse woody debris well distributed across the landscape in a manner that meets the needs of species and provides for ecological functions. Standards and guidelines should provide for appropriate coarse woody debris quantity, quality (such as species, decay stage and size) and distribution (ROD C-40).

A logical area to gather this information is within unmanaged, late-successional forests. However, it is important to realize that the data from these inventory plots and other CWD inventories have shown that there is very high variation in the amounts of snags and down wood in late-successional stands. In addition, it needs to be recognized that this plot data does not reflect levels of dead material immediately following a major disturbance (e.g., wildfire).

THE DYNAMICS OF COARSE WOODY DEBRIS

Levels of CWD across a landscape are affected by many factors. Tree growth and death patterns, fire, wind, insects, disease and decomposition all play a role in the dynamics of CWD. Understanding how these factors work in concert and describing or quantifying that process is difficult if not impossible. In addition, many of these factors vary in time and space making them even more difficult to define.

The approach to developing a CWD model in the Little River AMA focuses on the relatively steady state abiotic environment. The underlying abiotic and physical environment of the watershed influences all of the above factors to varying degrees. The idea that abiotic site factors influence numerous ecological phenomena has been well established in the literature (McCombs 1997). Swanson et al. (1988) describe how landform can effect climate, moisture gradients, nutrient availability, flow of energy and matter and disturbance patterns within a landscape. Rowe (1969) asserted that "...landform constitutes the relatively stable base of the landscape ecosystem and is, therefore, its best taxonomic feature."

A broad, but basic, abiotic attribute is landform and the most basic landform attribute is elevation. From elevation, slope steepness and aspect can be derived. More complex analyses can produce measures of the convexity or concavity of the land surface, slope position, forest site productivity (Wathen 1977), fire refugia (Camp 1995), plant association and topographic moisture (Henderson et al. 1992). Lindenmayer et al. (1991) used slope angle, topographic position, and various other landform measures to predict hollow-bearing trees for wildlife in Australia. Spies et al (1988) documented increased amounts of coarse woody debris in moister forest environments.

STRATIFYING THE WATERSHED

To stratify the Little River AMA using abiotic factor modeling, digital elevation models (DEM) corresponding to 7.5 minute topographic quadrangles were used. The DEMs have a resolution of 30 meters and an elevation value associated with each cell (0.2 acre cell size). From this data elevation, slope, aspect and landform (using a convexity index) were derived. These attributes were then combined (refer to the Upper Steamboat Creek watershed analysis for a more detailed description of this methodology - Appendix C) to produce an environmental moisture gradient map with three strata - dry, moderate and moist. A similar process is being developed to produce highly accurate forest type maps for the Virginia Gap Analysis (McCombs et al. 1998).

INVENTORY SAMPLE DESIGN

A randomized block design was used. The watershed was divided into three topographically distinct strata - dry, moderate and moist. Within each strata, late-successional stands greater than 20 acres in area were numbered and randomly selected. Within each stand, inventory plots were located systematically using a random start design. Plots were separated by approximately 450 feet. A total of 165 plots were placed within 29 unmanaged late-successional stands.

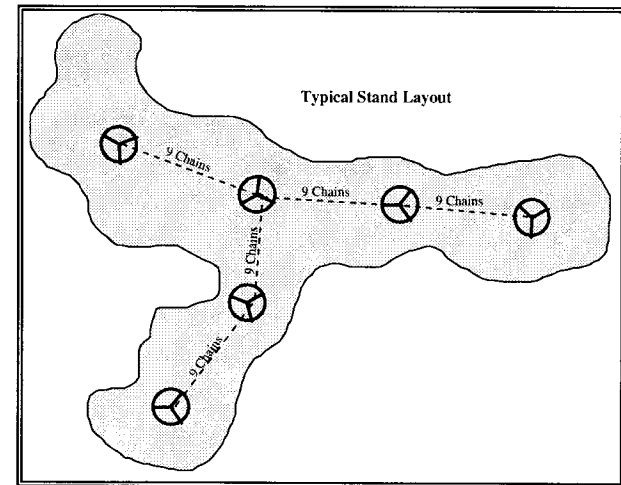Typical Stand Layout

INVENTORY METHOD

Coarse wood was inventoried within fixed radius circular plots (1 acre). Down wood was measured using a technique patterned after the Brown (1974) planar intersect method and similar to a methodology described by Bull et al. (1997). Three transects of random azimuth were laid out from plot center. Transects were 118 feet long for a total of 354 feet per plot (transect lengths were adjusted for slope).
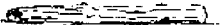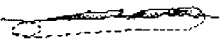

Plot Design
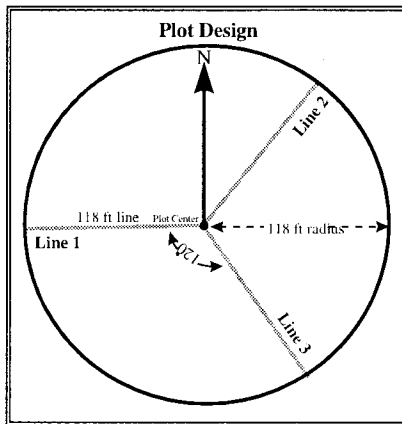
All fallen trees or log pieces intersected by transects were measured for diameter at both ends, length and decay class. Tree species was also recorded if it was identifiable. An inventory minimum standard of 6 inches diameter at large end and a minimum length of 8 feet was applied.

A total count of snags was performed in each plot. Species, diameter at breast height, total estimated height and decay class were recorded. Wildlife use (e.g., cavities or foraging sign) was also recorded. An inventory minimum height standard of 4.5 feet and a minimum diameter at breast height of 6 inches was applied.

In addition to coarse wood data, topographic data including plot aspect, slope and slope position, stand structure, tree species composition and plant association data were also collected. This data was entered into an computer database.

Decay Class 1	Decay Class 2	Decay Class 3
• Bark is intact	• Bark is loose and falling off	• Bark is missing to mostly missing
• Wood is hard	• Wood is hard to partly soft	• Wood is soft and decayed
• Limbs are mostly present	• Some to few limbs remaining	• Limbs are absent
• Bole is intact	• Bole is mostly intact	• Bole starting to or has lost form
• May have some top breakage	• May have top breakage (< 1/3)	• More than 1/3 to 1/2 top missing
• Bark is intact	• Bark is sloughing off, trace remains	• Bark is absent to mostly absent
• Wood is hard to partly soft	• Wood is hard to partly soft	• Wood is soft, blocky or powdery
• Log is supported above ground	• Log is sagging near ground	• Log is incorporating into ground

DEFINING DECAY CLASSES

For this inventory, snag and log decay classes were placed into three structural categories as described by Bull et al. (1997). Decay class 1 refers to recent mortality or live trees that have just fallen over. It is roughly equivalent to snag decay stage 1 and log decay classes 1 and 2 as described by Nietro and Bartels et al. (in Brown 1985).

Decay class 2 refers to snags that have been dead for a while and have lost some branches and bark. It also represents logs that are in contact with the ground and have lost some bark and branches. It is the equivalent to Brown's snag decay stages 2-3 and log decay class 3.

Decay class 3 represents snags and logs that have been dead for at least several years and are well into the decomposition processes. It is the rough equivalent to Brown's snag decay stage and log decay class 4 and 5.

These decay classes determine which wildlife are likely to use the CWD. They were grouped into 3 classes vs. 5 classes because it reduces the amount of field and analysis work required to analyze the data while still retaining important information.

Snag and Log Characteristics

A total of 2,291 snags and 1,593 logs were inventoried and measured. The physical dimensions were summarized across all decay and size classes for both snags and logs. Most of the CWD was from Douglas-fir. White fir accounted for the second most abundant CWD component (mostly above 4,000 ft. elev.). Western redcedar, western hemlock and incense cedar equally provided the third most abundant conifer component. Hardwood debris was dominated by Pacific Madrone and bigleaf maple.

Of the total number of snags, approximately five percent were greater than or equal to 40 inches d.b.h. Two percent of the down wood component was greater than or equal to 40 inches diameter at large end. Most of these large pieces of large CWD are from Douglas-fir, incense cedar and sugar pine. Western redcedar and white fir can also provide large diameter wood of this size.

Average Snag Heights (in feet)			
Decay Class	6-9 inch DBH	10-19 inch DBH	20+ inch DBH
1	38 ± 15	54 ± 28	91 ± 48
2	29 ± 17	35 ± 24	45 ± 27
3	15 ± 10	16 ± 12	23 ± 20

Average Log Lengths (in feet)			
Decay Class	6-9 inch LED	10-19 inch LED	20+ inch LED
1	30 ± 17	61 ± 33	102 ± 33
2	24 ± 11	44 ± 23	72 ± 36
3	22 ± 11	35 ± 23	54 ± 36

Plant Series/Strata Relationship
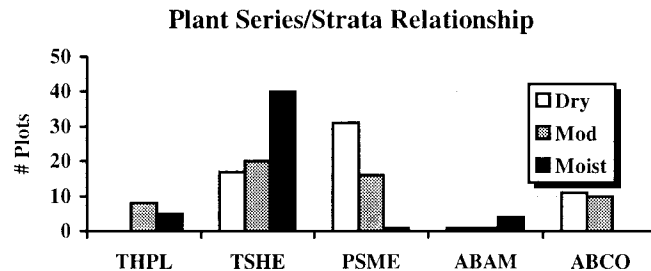
Preliminary Results

Based on the data collected from this inventory and a similar inventory in the Upper Steamboat Creek watershed (USDA 1997), there seems to be a relationship between abiotic factors and coarse woody debris. This relationship also ties in closely with plant series.

5

The following table summarizes the broad distribution and amounts of coarse woody debris within each of the three topographic strata. As seen in the upper Steamboat Creek watershed inventory and a study by Spies et al. (1988), the drier portions of the watershed (Dry Strata) have the lowest amounts of CWD. There does not seem to be much difference between the moderate and moist strata. The large decay class 1 material is highlighted and bold-faced in Table 1 as it relates more specifically to management prescriptions. Table 1 displays only the mean values. As expected with CWD, the standard deviations are high.

Table 1. Summary of coarse woody debris amounts found within unmanaged late-successional forests within the Little River AMA.

Diameter (inches)	Decay Class	Dry Strata			Moderate Strata			Moist Strata		
		PIECES/AC	FT/AC	SNAG/AC	PIECES/AC	FT/AC	SNAG/AC	PIECES/AC	FT/AC	SNAG/AC
6-9	1	5.0	148	1.7	3.9	119	1.7	3.5	104	0.9
	2	4.3	104	1.4	5.5	130	1.2	6.9	163	1.0
	3	7.1	159	0.4	6.0	136	0.6	16.6	373	0.7
10-19	1	4.9	298	2.6	5.9	356	2.3	6.5	396	1.8
	2	3.2	142	1.9	4.0	176	1.9	7.2	311	3.5
	3	12.8	449	0.8	16.1	566	1.5	39.0	1,374	2.2
20+	**1**	**1.2**	**123**	**1.2**	**2.5**	**258**	**1.5**	**1.8**	**187**	**1.6**
	2	1.7	102	1.7	1.8	129	2.0	2.3	165	1.7
	3	1.3	216	1.3	9.0	491	1.8	10.5	569	1.1

The average number of snags per acre does not differ greatly between strata and is 14.5 snags/acre in the moist to moderate environments and 13 snags/acre in the drier environments. Snag density is slightly lower than that seen in the Upper Steamboat Creek inventory (19 snag/ac) but is similar to densities estimated for dry historical forest types east of the Cascades (Harrod et al.1998).

The highest amount of CWD seems to be within the 10-19 inch diameter size classes. The interim standard and guideline in the Northwest Forest Plan requires retaining a minimum of 120 linear feet of logs (decay class 1) per acre greater than or equal to 16 inches in diameter and 16 feet long (ROD C-40). Approximately 51 percent of the plots (n=165) contained down wood of this size and decay class. Of these, 57 plots or 35 percent of all plots within late-successional forests met the current interim standard and guideline. It is apparent the CWD is distributed unevenly across the landscape with large "jackpots" occurring as a result of some periodic disturbance event (e.g., wind blowdown event).
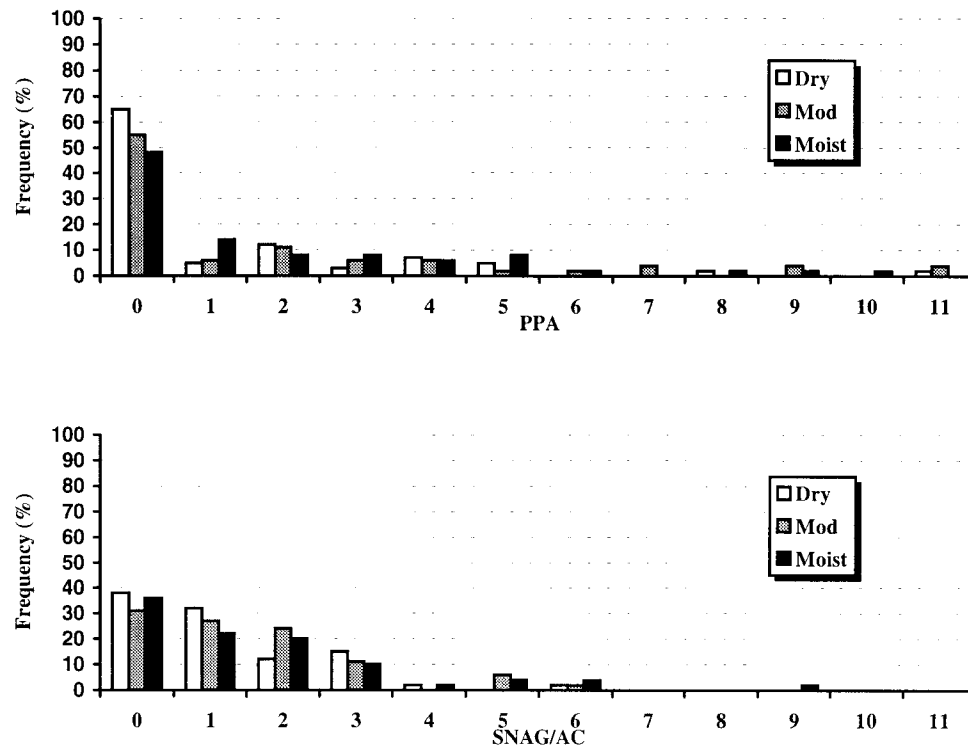
Figure 1. Frequency distribution of large decay class 1-2 logs and snags within the Little River Adaptive Management Area.

SPATIAL DISTRIBUTION

As mentioned previously, coarse woody debris is commonly distributed in a seemingly random and clumpy manner. To analyze the distribution of CWD for this report, the focus was on large diameter ($\geq$ 20 inches LED and DBH) logs or snags in decay class 1.

As shown in Figure 1, logs are more unevenly distributed across the landscape than snags. Over 50 percent of all plots do not contain large decay class 1 logs. Most of the remaining plots had 1-5 large pieces, mostly within the moist and moderate strata. There are more outlier plots with large "jackpots" of large logs than for snags. Out of all plots only five (3%) had recent, large down wood in excess of 1,000 ft/acre. The largest amount of big decay class 1 logs was 2,258 ft/acre. All but one of these "jackpots" occurred in the moderate strata.

Across all strata, approximately 35 percent of the plots did not contain recent large tree mortality. Most of the remaining plots contained 1-3 large decay class 1 snags. There were a few plots that had high densities of recent tree mortality. These pockets of snags are probably associated with small isolated outbreaks of disease or insects.

There does seem to be a distinct relationship between down wood levels for large decay class 1 wood and plant series. These levels are averages and again the distribution is clumpy.

Moisture	Plant Series	Ft/Acre
Moist	Western Redcedar	343
	Western Hemlock	319
	Pacific Silver Fir	207
↓	Douglas-fir	165
Dry	White Fir	99

WORK IN PROGRESS

More analyses are needed to fully understand the data collected this year. Currently, a process is being developed to manage for CWD in southwest Oregon. This process will add to the process described in this inventory and will likely attempt to include a watershed's disturbance regime into the CWD equation. Hopefully this inventory will serve as a good resource for that process in terms of what CWD exists in unmanaged late-successional forest habitat.

In addition, some plot centers still need to be recorded more accurately (spatially) using a global positioning system (GPS). Once this is complete, a plot summary report will be prepared which will provide a summary of the inventory data for each plot as well as four color photographs taken from plot center. This report can serve as a photo series for future coarse woody debris within the AMA. A few examples of completed plot summaries are attached in the appendix of this report.

SPECIES LIST

A list of scientific and common names for common tree and shrub species in the inventory area is provided below.

CONIFER TREES

Common Name	Scientific Name	Code
Douglas-fir	*Pseudotsuga menziesii*	PSME
Western hemlock	*Tsuga heterophylla*	TSHE
Western redcedar	*Thuja plicata*	THPL
Incense cedar	*Calocedrus decurrens*	CADE
Sugar pine	*Pinus lambertiana*	PILA
Western white pine	*Pinus monticola*	PIMO
White fir	*Abies concolor*	ABCO
Pacific silver fir	*Abies amabilis*	ABAM
Pacific yew	*Taxus brevifolia*	TABR

HARDWOODS

Common Name	Scientific Name	Code
Pacific madrone	*Arbutus menziesii*	ARME
Golden Chinqaupin	*Castanopsis chrysophylla*	CACH
Big leaf maple	*Acer macrophyllum*	ACMA
Bittercherry	*Prunus emarginata*	PREM
Canyon live oak	*Quercus chrysolepis*	QUCH
Oregon white oak	*Quercus garryana*	QUGA
Red alder	*Alnus rubra*	ALRU

SHRUBS

Common Name	Scientific Name	Code
Vine maple	*Acer circinatum*	ACCI
Pacific rhododendron	*Rhododendron macrophyllum*	RHMA
Salal	*Gaultheria shallon*	GASH
Oregon grape	*Berberis nervosa*	BENE

METRIC CONVERSIONS

1 foot = 0.3048 meters   1 acre = 0.4047 hectare

1 inch = 2.54 centimeters   1 acre = 4047 square meters

1 chain = 20.1 meters

LITERATURE CITED

Bull, E.L., C.G. Parks and T.R. Torgersen. 1997. Trees and logs important to wildlife in the Interior Columbia River Basin. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-391. 55 p.

Brown, E.R. (ed). 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington Part 1. USDA For. Serv. PNW. 332p.

Brown, J.K. 1974. Handbook for inventorying downed woody material. USDA For. Serv. Gen. Tech. Rep. INT-16. 24 p.

Camp, A.E. 1995. Predicting late-successional fire refugia from physiography and topography. Ph.D. Dissertation, Univ. of Washington, Seattle, WA. 137 p.

Harrod, R.J., W.L. Gaines, W.E. Hartl and A.E. Camp. 1998. Estimating historical snag density in dry forests east of the Cascade Range. Gen. Tech. Rep. PNW-GTR-428. Portland, OR: U.S. Department of Agriculture, For. Serv., Pacific Northwest Research Station. 16 p.

Henderson, J.A., R.D. Lesher, D.H. Peter and D.C. Shaw. 1992. Field guide to the forested plant associations of the Mt. Baker-Snoqualmie National Forest. Report R6-Ecol-TP-028-91. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 196 p.

Lindenmayer, D. B., R. B. Cunningham, H. A. Nix, M. T. Tanton, and A. P. Smith. 1991. Predicting the abundance of hollow-bearing trees in montane forests of southeastern Australia. Australian J. Ecol. 16:91-98.

McCombs J.W. 1997. Geographic information system topographic factor maps for wildlife management. M.S. Thesis. VPI and SU, Blacksburg, VA. 153 p.

McCombs, J.W., S. Klopfer, D. Morton and J. Waldon. 1998. An alternative approach to land cover mapping in complex terrain. GAP Bulletin Number 6. 3 p.

Rowe, J. S. 1969. Plant community as a landscape feature. p. 63-81. in K. N. H. Greenidge (ed.). Symposium in terrestrial plant ecology, Oct. 1966, Saint Francis Xavier Univ., The Nova Scotia Museum, Halifax, N. S.

Spies, T.A., J.F. Franklin and T.B. Thomas. 1988. Coarse woody debris in Douglas-fir forests of western Oregon and Washington. Ecol. 69(6):1689-1702.

Swanson, F. J., T. K. Kratz, N. Caine, and R. G. Woodmansee. 1988. Landform effects on ecosystem patterns and processes: Geomorphic features of the earth's surface regulate the distribution of organisms and processes. Bioscience 38(2):92-98.

USDA. 1997. Upper Steamboat Creek watershed analysis. USDA For. Serv. W.A., Umpqua National Forest. 157 p.

USDA/USDI. 1994. Record of decision (ROD) for amendments to Forest Service and BLM land management planning documents within the range of the northern spotted owl.

Wathen, S. A. 1977. Maximum insolation on a surface as an estimator of site quality. M.S. Thesis. VPI and SU, Blacksburg, VA. 41pp.